

all of the tasks associated with the systems' and equipment's intended functions. Such installed equipment and systems must meet the following requirements:

(a) Flight deck controls must be installed to allow accomplishment of all the tasks required to safely perform the equipment's intended function, and information must be provided to the flightcrew that is necessary to accomplish the defined tasks.

(b) Flight deck controls and information intended for the flightcrew's use must:

(1) Be provided in a clear and unambiguous manner at a resolution and precision appropriate to the task;

(2) Be accessible and usable by the flightcrew in a manner consistent with the urgency, frequency, and duration of their tasks; and

(3) Enable flightcrew awareness, if awareness is required for safe operation, of the effects on the airplane or systems resulting from flightcrew actions.

(c) Operationally-relevant behavior of the installed equipment must be:

(1) Predictable and unambiguous; and

(2) Designed to enable the flightcrew to intervene in a manner appropriate to the task.

(d) To the extent practicable, installed equipment must incorporate means to enable the flightcrew to manage errors resulting from the kinds of flightcrew interactions with the equipment that can be reasonably expected in service. This paragraph does not apply to any of the following:

(1) Skill-related errors associated with manual control of the airplane;

(2) Errors that result from decisions, actions, or omissions committed with malicious intent;

(3) Errors arising from a crewmember's reckless decisions, actions, or omissions reflecting a substantial disregard for safety; and

(4) Errors resulting from acts or threats of violence, including actions taken under duress.

[Doc. No. FAA-2010-1175, 78 FR 25846, May 3, 2013]

§ 25.1303 Flight and navigation instruments.

(a) The following flight and navigation instruments must be installed so that the instrument is visible from each pilot station:

(1) A free air temperature indicator or an air-temperature indicator which provides indications that are convertible to free-air temperature.

(2) A clock displaying hours, minutes, and seconds with a sweep-second pointer or digital presentation.

(3) A direction indicator (non-stabilized magnetic compass).

(b) The following flight and navigation instruments must be installed at each pilot station:

(1) An airspeed indicator. If airspeed limitations vary with altitude, the indicator must have a maximum allowable airspeed indicator showing the variation of V_{MO} with altitude.

(2) An altimeter (sensitive).

(3) A rate-of-climb indicator (vertical speed).

(4) A gyroscopic rate-of-turn indicator combined with an integral slip-skid indicator (turn-and-bank indicator) except that only a slip-skid indicator is required on large airplanes with a third attitude instrument system useable through flight attitudes of 360° of pitch and roll and installed in accordance with § 121.305(k) of this title.

(5) A bank and pitch indicator (gyroscopically stabilized).

(6) A direction indicator (gyroscopically stabilized, magnetic or non-magnetic).

(c) The following flight and navigation instruments are required as prescribed in this paragraph:

(1) A speed warning device is required for turbine engine powered airplanes and for airplanes with V_{MO}/M_{MO} greater than $0.8 V_{DF}/M_{DF}$ or $0.8 V_D/M_D$. The speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots, whenever the speed exceeds V_{MO} plus 6 knots or $M_{MO} + 0.01$. The upper limit of the production tolerance for the warning device may not exceed the prescribed warning speed.

§ 25.1305

14 CFR Ch. I (1–1–14 Edition)

(2) A machmeter is required at each pilot station for airplanes with compressibility limitations not otherwise indicated to the pilot by the airspeed indicating system required under paragraph (b)(1) of this section.

[Amdt. 25–23, 35 FR 5678, Apr. 8, 1970, as amended by Amdt. 25–24, 35 FR 7108, May 6, 1970; Amdt. 25–38, 41 FR 55467, Dec. 20, 1976; Amdt. 25–90, 62 FR 13253, Mar. 19, 1997]

§ 25.1305 Powerplant instruments.

The following are required powerplant instruments:

(a) *For all airplanes.* (1) A fuel pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.

(2) A fuel quantity indicator for each fuel tank.

(3) An oil quantity indicator for each oil tank.

(4) An oil pressure indicator for each independent pressure oil system of each engine.

(5) An oil pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.

(6) An oil temperature indicator for each engine.

(7) Fire-warning devices that provide visual and audible warning.

(8) An augmentation liquid quantity indicator (appropriate for the manner in which the liquid is to be used in operation) for each tank.

(b) *For reciprocating engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required:

(1) A carburetor air temperature indicator for each engine.

(2) A cylinder head temperature indicator for each air-cooled engine.

(3) A manifold pressure indicator for each engine.

(4) A fuel pressure indicator (to indicate the pressure at which the fuel is supplied) for each engine.

(5) A fuel flowmeter, or fuel mixture indicator, for each engine without an automatic altitude mixture control.

(6) A tachometer for each engine.

(7) A device that indicates, to the flight crew (during flight), any change in the power output, for each engine with—

(i) An automatic propeller feathering system, whose operation is initiated by a power output measuring system; or

(ii) A total engine piston displacement of 2,000 cubic inches or more.

(8) A means to indicate to the pilot when the propeller is in reverse pitch, for each reversing propeller.

(c) *For turbine engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required:

(1) A gas temperature indicator for each engine.

(2) A fuel flowmeter indicator for each engine.

(3) A tachometer (to indicate the speed of the rotors with established limiting speeds) for each engine.

(4) A means to indicate, to the flight crew, the operation of each engine starter that can be operated continuously but that is neither designed for continuous operation nor designed to prevent hazard if it failed.

(5) An indicator to indicate the functioning of the powerplant ice protection system for each engine.

(6) An indicator for the fuel strainer or filter required by § 25.997 to indicate the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with § 25.997(d).

(7) A warning means for the oil strainer or filter required by § 25.1019, if it has no bypass, to warn the pilot of the occurrence of contamination of the strainer or filter screen before it reaches the capacity established in accordance with § 25.1019(a)(2).

(8) An indicator to indicate the proper functioning of any heater used to prevent ice clogging of fuel system components.

(d) *For turbojet engine powered airplanes.* In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required:

(1) An indicator to indicate thrust, or a parameter that is directly related to thrust, to the pilot. The indication